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# Lubrication

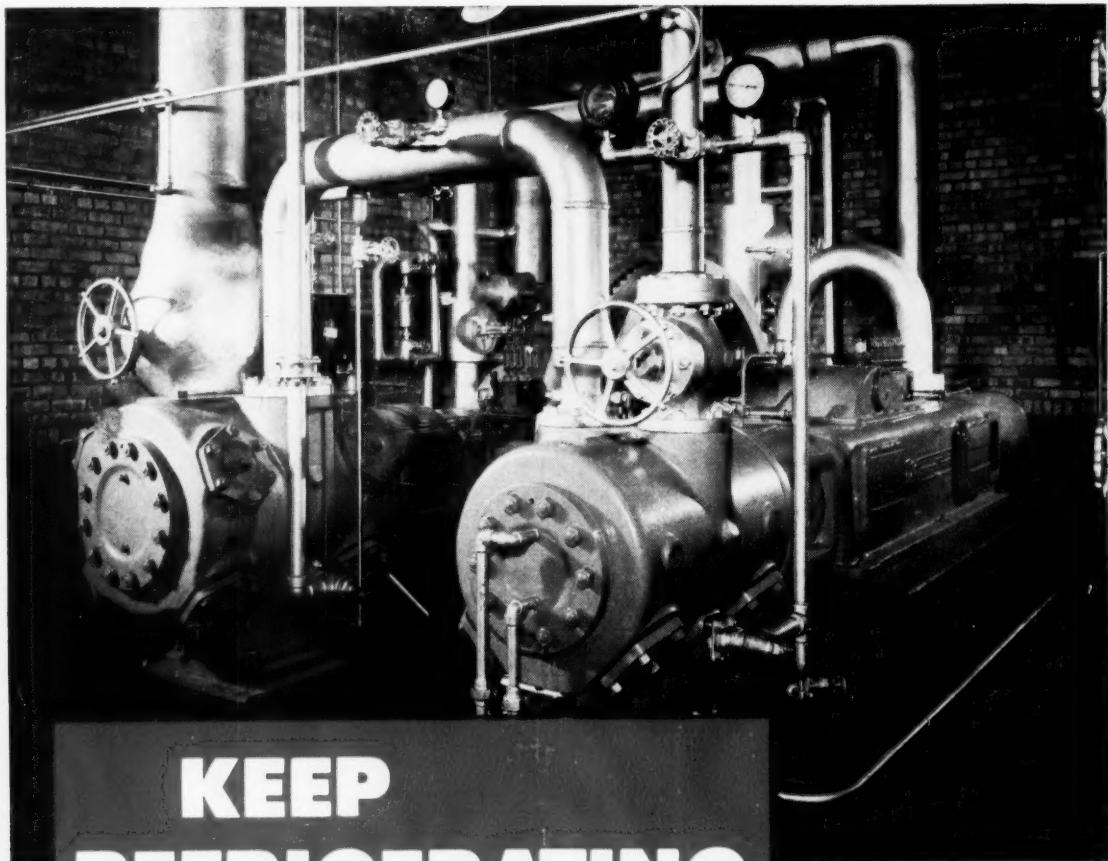
A Technical Publication Devoted to  
the Selection and Use of Lubricants

## THIS ISSUE

Lubrication in the  
Meat Packing  
Industry



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# LUBRICATION

A TECHNICAL PUBLICATION DEVOTED TO THE SELECTION AND USE OF LUBRICANTS

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## Lubrication In The Meat Packing Industry

DURING the past decade, the meat packing industry has been modifying and modernizing in order to present the consumer with more attractive products, to increase efficient production and to reduce overhead costs. This is being accomplished largely by the installation of new modern machines which speed up production, save labor, and promote safer low cost operation. Present day machinery is designed to closer tolerances and includes the extensive use of ball and roller bearings, high speed gears, and chain drives. Consequently, satisfactory operation of meat packing equipment depends more than ever upon the proper selection and application of lubricants.

No two meat packing plants are exactly alike in the way they are built, equipped, or function. They vary in size depending upon the population served and the number of operations performed. However, there are certain lubrication requirements which are basic and which apply generally throughout the industry. Some of these will be discussed herein:

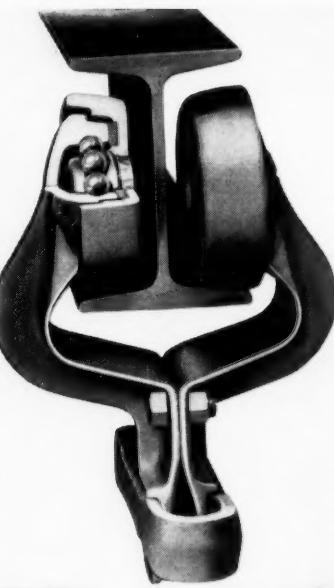
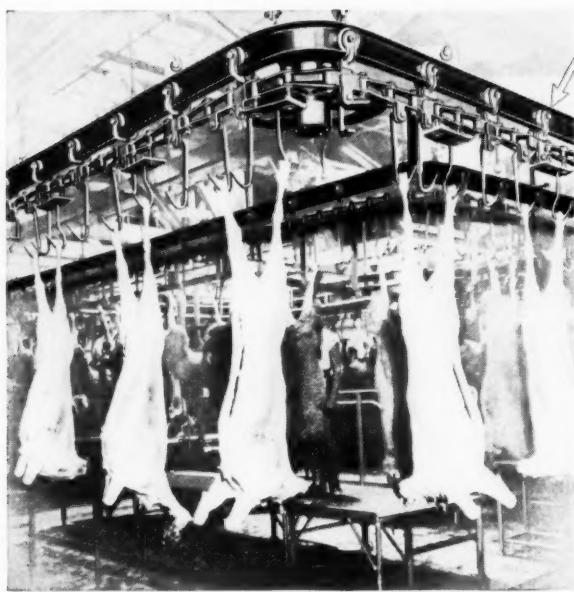
### REFRIGERATION

Refrigeration is accomplished by either direct or indirect means. In the former, the refrigerant or cold material works inside of coils located in the compartment, tank, or material which it is to cool. In the latter, the refrigerant chills an intermediate material such as air, brine or water (ice)

which is subsequently transferred to locations containing the meat products to be cooled. Modern systems of refrigeration depend upon combinations of evaporation and condensation for this action. In the evaporation phase, a suitable liquid is evaporated under controlled conditions thereby absorbing heat from the surroundings at the desired rate. The refrigerant vapor then is compressed at high pressure and led through suitable cooling coils where it is condensed again to the liquid form for reuse. The compressor takes suction from the low pressure expansion coils where evaporation and refrigeration have taken place, and discharges to the condensing coils where heat is extracted, usually by cooling water.

Absorption refrigeration is a slight modification in which the vaporized refrigerant is dissolved in an absorbing liquid. The concentrated absorbing liquid is pumped to a generator where heat is applied to drive off the refrigerant vapor in an impure form. It is purified in a rectifier and then is passed to condensing coils where it is liquefied by cooling water. The system from generator through rectifier and condenser is operated under high pressure, so that the condensed refrigerant is then ready to be released into the expansion coils to begin a new cycle.

In selecting lubricants for refrigeration machinery, consideration must be given to the service involved and the operating conditions that prob-



*Courtesy of Link Belt*

Figure 1 — Overhead Sheep Dressing Conveyor. Cutaway shows ball bearings in the roller.

ably will be encountered. In addition, the effect of lubricants upon parts not requiring lubrication, as well as on actual bearing surfaces, is an important factor. Oil in any part of a cooling system when it becomes immiscible with the refrigerant will tend to reduce refrigerating efficiency by coating heat transfer surfaces, retarding refrigerant flow, or unbalancing the pressure relations for which the equipment was designed. It is imperative, therefore, that the lubricant remain fluid at the lowest temperature to which it may be subjected in the expansion or refrigerating side of the system. An oil with a sufficiently low pour point is necessary to meet these conditions. A further requirement of low temperature performance is that the oil be free from waxy material. This characteristic can be measured by the Haze and Floc Test in which the temperatures of separation and coagulation of wax from a solution of lubricant and Freon 12 are visually observed. These temperatures are indications of the suitability of the oil for use at the desired system temperatures.

Water is objectionable in any cooling system since it will form ice if temperatures are below 32°F. and also may contribute to the corrosiveness of certain refrigerants towards metals. Thus, it is important that the lubricant contain no water. This is assured by manufacturing the oil to a high dielectric constant, delivering it in sealed containers, and exercising extreme care in bulk handlings. In some instances, it may be advisable to blotter press the lubricant prior to use in order to remove any moisture inadvertently absorbed.

An oil most suitable for use in refrigeration systems does not vaporize or foam excessively. These characteristics are necessary to prevent undue carry-over into the refrigeration circuit. The lubricant also should be highly refined to remove unstable materials and thus minimize the possibility of any deposit formation.

The selection of the proper viscosity grade for the equipment involves consideration of the manufacturers' recommendations, compressor design, condition of cylinder walls and other moving parts, in conjunction with the means provided for oil separation prior to the refrigeration section of the unit. In general, a viscosity near 150 seconds Saybolt Universal at 100°F. is satisfactory for installations with temperatures below 5°F. and approximately 200-300 seconds for units having refrigerating temperatures above 5°F. Certain installations may require a product of 500 seconds viscosity.

In the operation of refrigerating units good lubrication practices are necessary to maintain high efficiency. The oil level must be correct to provide an adequate reservoir and head for the suction of a pressure system and the degree of agitation necessary in a splash system. Too high a level of oil is apt to give excessive oil on cylinder wall or other parts and pass the excess into the refrigerant stream which obviously is not desirable. On the other hand, a low oil level can result in excessive wear or seizure due to the lack of sufficient lubrication. Adjustments to splash or pump mechanisms, rings and bearing fit can be made to assure adequate oil

## LUBRICATION

supply without encountering a detrimental excess or shortage. The condition of the seals should be checked periodically to prevent excessive leakage and waste of oil.

Ordinarily an oil separator is incorporated in any installation where appreciable oil can get into the refrigerant. Since refrigerant-oil mixtures or solutions are extremely difficult to separate, the oil separator is designed to function while the refrigerant is in gaseous form. The desirable location of the separator is before the condenser section and a distance from the compressor to allow efficient coagulation and precipitation of the oil from the refrigerant gas. The efficiency of the separator can be checked by comparing the amount of oil removed with the amount fed to the compressor.

### RUST PROTECTION

Machinery and equipment in meat packing plants operate in an environment which is most conducive to the formation of rust and corrosion. The ill effects of rust and corrosion are well known, and consequently it is felt that a section devoted specifically to protection against them is in order. High sanitation standards are required of this industry, therefore, the rooms and equipment are washed periodically with hot water or steam. Under such extreme conditions it is a never ending effort to prevent rust and promote adequate lubrication. Furthermore, some pieces of equipment such as trucks and conveyors are exposed to temperatures ranging from 20 to 100°F. and even more extreme in some cases. Lubricants can be exposed to contamination by water, caustics, acids, organic waste matter and temperature variations.

### Lubricants Applicable to Wet and Corrosive Conditions

The ideal lubricant required to fulfill a need of the meat packing industry would have the protective characteristics of rust preventive compounds and excellent lubricating properties found in premium quality lubricants. The need has increased even more with the use of ball and roller bearings and new high speed precision equipment. At one time, such a lubricant was not in sight.

The first practical approach to the problem of lubricating machinery adequately under wet and corrosive conditions is one of design and maintenance. Bearings must be designed to prevent contaminants from getting to the lubricant. Means to remove contaminating material from the lubricating system should be provided. A schedule of relubrication is necessary to ensure adequate replacement of contaminated lubricant. It is realized, however, that bearing seals are seldom perfect and contami-

nation will be present. The lubricant therefore, is expected to protect the metal surfaces as well as reduce friction.

### Oils

In order to obtain better rust protection than that afforded by straight mineral oils, several types of products are made available by the petroleum supplier such as compounded, "adhesive" and inhibited oils. Compounded oils contain agents which surround the water particles and prevent penetration of the oil film. Some agents attach themselves to the metal surface and displace the moisture present. Compounded oils will also carry a somewhat higher load than straight mineral oils. "Adhesive" oils adhere to the metal and resist throwoff or replacement by water. Care must be taken in application of these products so that clogging of lines or wick feed will not occur. Both types of products may be limited in use by extreme variations in temperatures and conditions favorable to oxidation. Oils may also contain rust and oxidation inhibitors and these are generally highly refined premium type products. Such products are normally recommended for turbines and hydraulic systems. It should be noted that many premium grade motor oils contain inhibitors which, in addition to other properties, offer excellent anti-rust characteristics. Some inhibitors in oils offer protection to a lubricating system while the parts are in motion or shut down for a relatively short period of time. While a variety of petroleum oils are available which offer protection under wet operating conditions, the selection of the proper

*Courtesy of The Cincinnati Butcher's Supply Co.*



Figure 2 — Drive Unit of Chain Hoist.

product depends also upon operating temperatures, speeds, conditions of operation, e.g. intermittent or steady, amount of water contamination encountered, type of lubricating dispensing equipment, type of bearing loads, etc.

#### Greases

The behavior and general characteristics of common soap base greases in relation to water and various temperatures have been discussed in many publications. Advances in the quality of grease have been such that it is necessary to modify general concepts used several years ago. For example, water insoluble calcium soap grease was described as limited in application due to low dropping point and the tendency to separate at temperatures approaching 212°F. Today anhydrous calcium base greases are available that retain the desirable water resistant characteristics and in addition are suitable for steady operation in the approximate range of 250°F. to -40°F. They provide satisfactory lubrication in relatively high speed bearings with no leakage and little change in consistency and they

resist oxidation while providing good distribution in the bearings. Similar progress is being made with other soap base greases. New techniques in manufacture, plus the addition of rust and oxidation inhibitors and extreme pressure agents have enabled grease manufacturers to modify and improve undesirable limitations of any type of base grease.

Lithium base greases have recently been promoted because of the wide variety of application. They are water resistant and have good metal wetting properties. It should be noted, however, that some lithium greases absorb water to such an extent the grease will not adhere to or wet the bearing surface and thus lose their ability to lubricate.

Greases tailored for either very high or very low temperatures should be used for operating temperature recommended by the supplier. For normal industrial use a NLGI No. 2 classification lithium soap grease will perform satisfactorily in bearings at temperatures from somewhat below 250°F. to about -40°F. These limits can vary somewhat depending on ingredients used in manufacture. Products are being developed which have additional built-in rust and oxidation resistant characteristics and exhibit good mechanical stability in the presence of water. Extreme pressure properties are also added to some greases of this type. While lithium soap multi-purpose grease is one product suitable for many different applications, in certain operations a specially designed grease with the required unique characteristics applicable to the specified conditions would be more highly recommended.

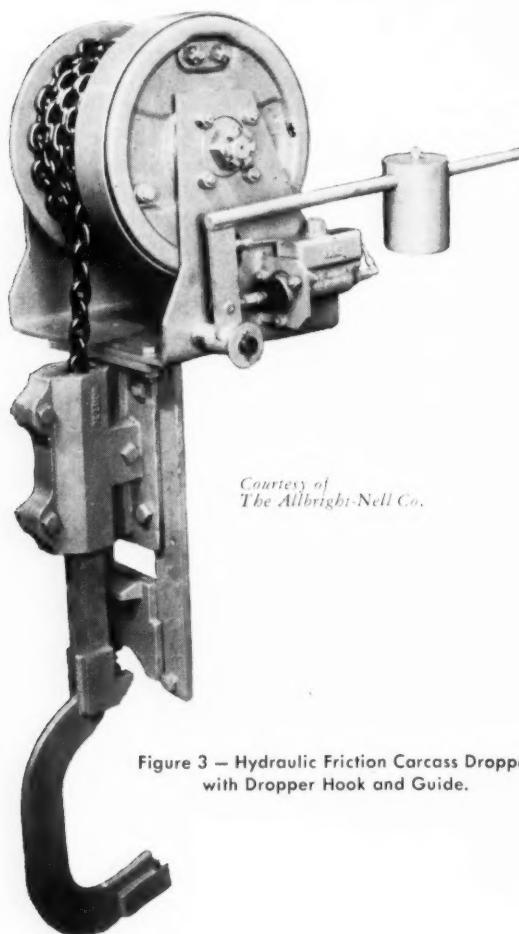
#### Rust Preventive Compounds

During the past ten to fifteen years petroleum base rust preventives have been used extensively on metal structures and have been found to be effective and economical in their application. These petroleum materials are available in liquid, semi-solid non-hardening type and semi-solid hardening type. This variety is necessary to provide protection of: (1) iron and steel structures with rough surfaces where the primary object is to prevent rust from reducing thickness and thus making unusable such items as tanks, pipes, pumps, and conveyor rails. (2) smooth, machined or processed surfaces in storage where even small changes in dimensions cannot be tolerated e.g. anti-friction bearings, machined spare parts and tools.

Corrosion of plant equipment is affected by the environment which includes alternate wetting and drying and exposure to corrosive gases, acids and alkali. In most cases the equipment can be protected if the surfaces are provided with a barrier which prevents a corrosive environment from reaching the surface. Such a barrier may also

*Courtesy of  
The Albright-Nell Co.*

Figure 3 — Hydraulic Friction Carcass Dropper with Dropper Hook and Guide.



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*Courtesy of The Cincinnati Butcher's Supply Co.*

Figure 4 — Hog Dehairing Machine.

have incorporated in it, as do certain petroleum base rust preventives, the characteristics of either neutralizing rust formation or actively combining with the surface to form an impermeable protective coating.

In any selection of petroleum rust preventives the degree of protection needed is the primary consideration. The next consideration is the ease of application and ease of removal.

The degree of protection needed depends upon whether the material requires temporary or long time protection; whether it is exposed to dry or wet atmospheres; whether it is a rough part or a machined part where no deterioration can be tolerated; whether the conditions of exposure include the presence of dust, acid fumes or other deteriorating materials. Normally the greatest protection is afforded by thicker films such as those obtained in application by brushing or dipping. These applications, when properly applied, can give outside protection up to three years. It should be noted that petroleum base semi-solid rust preventives have melting points in the range of 140 to 160°F. and should be used only on surfaces where the temperatures are somewhat lower.

Application by brushing, dipping or spraying is normally used. Heavier products can be applied by any of these methods if thinned with solvent or heated. Dipping conserves labor and effectively covers all parts of surfaces to be protected. The

solvent type rust preventive is most easily applied. When a product containing solvents is heated, special precautions are necessary to prevent a fire hazard and to protect personnel from fumes. Normally spraying should be accomplished only in open or in well ventilated areas where there is no possibility for solvent fumes to concentrate. Care should be taken to ensure that solvents do not contaminate food products. Brushing requires the most manpower but spraying and dipping necessitate certain additional equipment.

Petroleum base rust preventives can be removed with solvents but somewhat more effort is necessary to remove thicker coats. The hard drying solvent types which are asphaltic in nature are usually applied only where subsequent removal is not anticipated.

The best results are obtained when the metal surfaces are properly cleaned before application of rust preventives.

### LUBRICATION IN SLAUGHTERING AND DRESSING OPERATIONS

If all kinds of livestock are to be slaughtered, there will usually be provisions for: 1) a killing floor for cattle, calves and lambs with provisions for coolers and auxiliary rooms for warm fancy meats and curings; 2) hog killing floor and cooler; 3) cutting room for beef and small stock; 4) pork cutting room; 5) curing cellars; 6) cold storage freezers; 7) hide cellar; 8) oil house; 9) tank house; 10) smoke house; 11) table-ready



*Courtesy of The Allbright-Nell Co.*

Figure 5 — Pickle Injector.

meats kitchen; 12) lard refinery; 13) vegetable oil refinery; 14) fertilizer and bone house.

By-products departments which may be found are: 1) soap factory; 2) glue factory; 3) gelatin factory; 4) margarine factory; 5) wool house; 6) hydrogenating plant.

The lubrication engineer in the meat packing industry is confronted with some fundamental service operating conditions not always found in other industries. The majority of products processed are intended for consumption by humans and animals, consequently, the edible food must be free of inedible material. In addition, the edible product must appeal to the consumer and it is important that care is taken to prevent discoloration of the meat products. If this should happen the contaminated portion of the meat must be cut out, which requires an extra operation and reduces the value of the cut of meat.

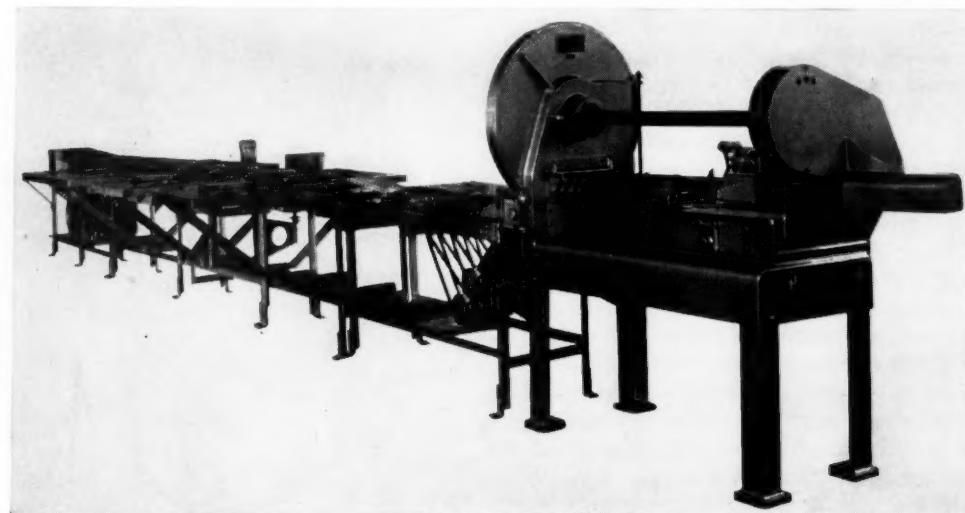
A meat packing plant is divided into departments which are designed to process parts of the carcass. To facilitate transportation of the carcass and sections thereof, conveyors of many types, chutes, trucks and elevators are used. To accomplish the task of sectioning and moving the carcass such machinery as electric saws, hoists, power drops, head splitters, jaw pullers and other equipment are employed. Much of the lubrication requirements of the various machines are similar to each other in that they may involve bearings, worm drive, electric motors, chains and reduction gears. The ambient temperature can at times become quite warm and even reach over 100°F. Consequently the humidity can also be quite high. When equipment is shut down overnight and the temperature cools down, formation of condensation adds

to the problem of lubrication as previously discussed. The overhead conveyors also need special consideration and the lubricant must be selected with care. The lubricant should be light in color and not drip on the carcass. Even if proper lubricant is available, its usefulness can be nullified if just the right amount is not applied. Too much lubricant on overhead conveyors and their component parts well may be the major cause of drippage. Trolley wheels require a similar type of lubricant and it must be kept in mind that the lubricant should not contact the meat.

Electric power saws are not difficult to lubricate if it is remembered that a premium product should be applied at prescribed intervals. They may be designed for either grease or oil. The grease is normally a NLGI Number 2 classification specially designed for ball and roller bearings. A premium product will protect against moisture, resist oxidation, and be stable under various conditions of shear. The oil should have a viscosity as recommended by the manufacturer. In addition, it should be highly refined and resist corrosion or rust, gum formation, and oxidation.

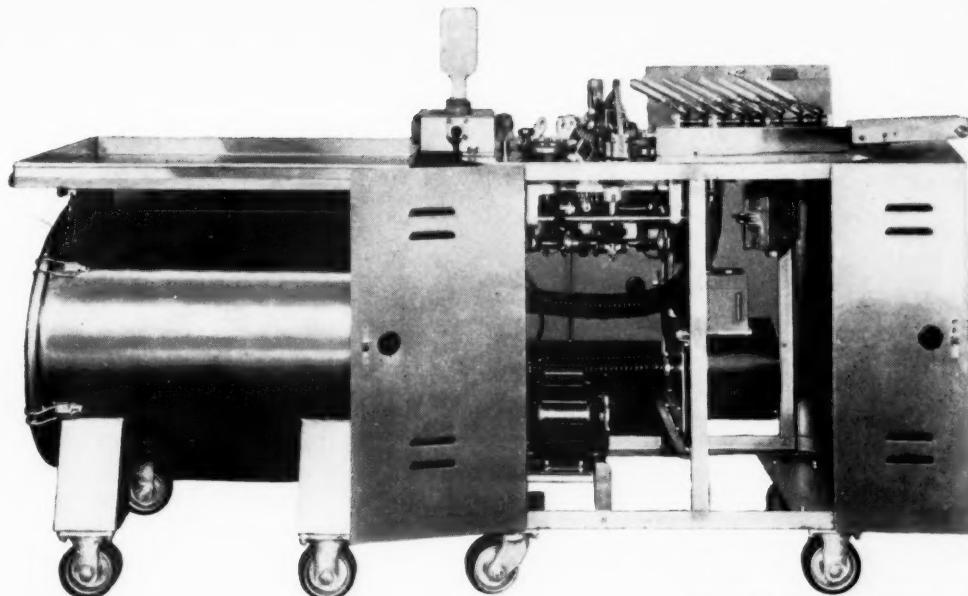
The bearings found in moving pan type conveyors are lubricated with a NLGI Number 2 or 3 classification product depending upon the service conditions. The grease forms a seal against water and other contaminants as well as protects against rusting.

The processes involved with hog slaughtering and dressing have many operations similar to those used with cattle and sheep. Fundamental differences are that hogs must be dehaired; the size and shape of their bones are generally unsuitable for manufacturing purposes; and they have a higher



*Courtesy of The Allbright-Nell Co.*

Figure 6 — Hydramatic Bacon Slicer and Conveyor.



*Courtesy of Linker Machines Inc.  
Bijur Lubricating Corp.*

Figure 7 — The Ty Peeling Machine removes cellulose casings in the manufacture of skinless wieners. Internal gears, bearings, clutches and chain drives are automatically lubricated.

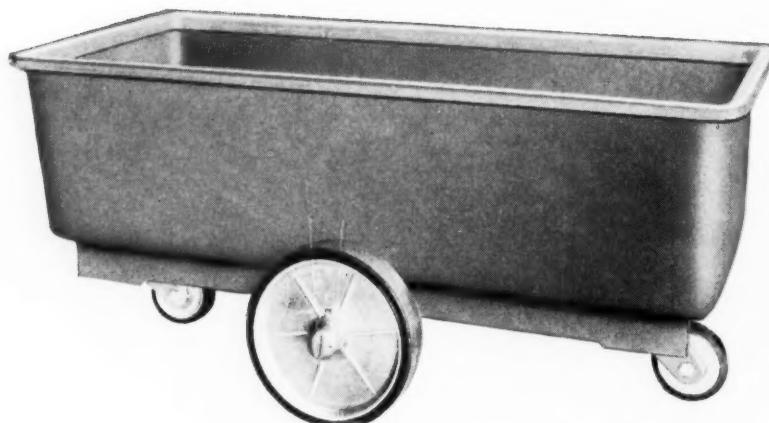
percentage of fat. To remove the hair from the hog carcass it must be conditioned through a scalding tub at 136-142°F. and passed through a dehauling machine. These machines vary somewhat in size and detail of operations but consist mainly of fabricated paddles which beat the bristle off as the carcass is moved around. At the same time the carcass is generally subjected to hot water spray. Since water conditions in this process are severe, continued relubrication is necessary. In cases where oil is required, it may be heavy bodied depending on the load. Automatic feed and adequate seals help to maintain lubrication. If grease lubricated, it must resist washout by being adhesive and water insoluble.

The parts of the hog carcass are conveyed to the various departments for further processing into bacon, hams, etc. The pork cutting department is normally cooled to about 50°F. Moving top tables transport the pork cuts to where portable band saws, skinning machines, and rollers, are employed in processing. The lubrication requirements are discussed under general headings such as bearings, gears, and chains.

#### Sausage and Bacon

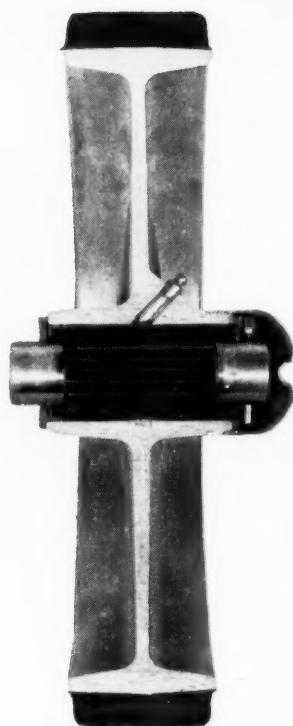
The sausage and bacon departments include machines which are intricate and precise. The operation of sausage and frankfurter manufacture involves grinding the meat and fat. The grinders are powered by an electric motor coupled to a herringbone gear drive attached to a screw feed.

The gear drive and roller bearing are double sealed to prevent escape of the oil into the food. The meat and other substances are placed in cutters or choppers which are large revolving bowls which move the meat under the knives. The bowl turns on ball bearings and power is transmitted through a worm drive. The mixing of meat and spices is carried out in a meat mixer. This consists of a hopper with paddles attached to a shaft and driven by a belt from an electric motor. The paddle shaft bearings are surrounded by stuffing boxes and driven by spur gears. Some mixers have a tight cover, and the operation is carried out under vacuum. The sausage or frankfurter meat is placed into a stuffer which is a cylinder containing a piston. The sausage or frankfurter meat is forced into the casings by compressed air. A sausage or frankfurter linking machine measures, loops and ties the sausage in successive operation. If the links are to be cooked or cured, they are placed on racks or "trees" and put into the automatic cookers or smoke house. After cooking, the frankfurters may be run through a peeling machine which removes the synthetic casing and gives skinless frankfurters. Peeling machines remove the casings of 400-600 pounds hourly. Frankfurters pass through a steam bath which expands the casing to facilitate removal. They then pass under knives which separate the string and cut the casing. Individual links move over a suction section which takes hold of a piece of the casing and removes it with a spiral motion.



*Courtesy of The Allbright-Nell Co.*

Figure 8 — Hand Truck for Sausage Meat with Cross Section of a Wheel Showing Roller Bearings.



Bacon is conditioned and later shaped by a hydraulically operated bacon press after being held in storage at about 20°F. Injection of a pickle solution into bellies to cure bacon can now be done by machines which average 12 to 16 lbs. bellies per minute. A conveyor moves the bellies to a point where needles inject cure at the rate of 50 injections per minute. A speed reducer drives the conveyor and a cam operates the directional valve of hydraulic pumps which drive the needles up and down and move the piston of the drive pump. The oil recommended for the hydraulic system and reducer is a highly refined product with a Saybolt viscosity at 100°F. of approximately 150 seconds containing anti-rust and anti-oxidation inhibitors. The white paraffine base grease of NLGI classification Number 1 or 2 is also required. The bacon is sliced at temperatures no higher than 38°F. and up to 800 slices per minute can be cut on a typical machine. The equipment requires a rust and oxidation inhibited hydraulic oil and a premium ball and roller bearing grease.

Today the shopping habits of the consumer require that products be sliced, weighed and packaged before delivery to "self service stores". Now meat plants not only maintain and operate canning machines but they also use wrapping machines. Machines of this type are intricate, accurate and fast. The parts are made to close tolerances and operate with amazing precision. Besides requiring proper maintenance and adjustment, the

machines also must be protected against wear, contamination and build-up of deposit formation on the moving parts. Satisfactory operation and reduction of downtime is aided to a great extent by the proper application of lubricants. Nothing but the highest quality lubricant available should be applied to machines of this type. It must not separate or oxidize to form soap or gummy deposits. The grease should shear easily under high speeds and yet maintain its proper consistency. At the same time it must protect against rust formation and contamination of the metal surfaces. The oil is usually of a 100-300 second viscosity at 100°F. and also is resistant to oxidation and protects against deposits, contamination and rust. Such qualities are found in highly refined inhibited oils.

### Hand Trucks

A variety of hand trucks are employed throughout the plant. Some are used for special purposes such as hanging sausage and frankfurters and will more or less stay in one location. On the other hand, meat trucks, bacon chilling trucks, etc. may move from warm to cold rooms. In addition, the trucks frequently are cleaned with hot water and even steam. The truck bodies may be aluminum, stainless steel or galvanized. The wheels are mounted on roller bearings with neoprene and steel retainer rings. The caster wheels have roller bearings in the wheels and ball bearings in the swivels. The swivels are squirted with oil prefer-

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ably with good rust preventive qualities and tenacious properties. A ball and roller bearing grease suitable under wet and wide temperature conditions is recommended for the wheels.

### Rendering Equipment

The principal object in rendering animal products is to separate the free fats from other products.

Although types of cookers may differ somewhat in construction, the following lubrication guide will generally fit most requirements. The herringbone gear and bearings with oil type fittings use oils with 900-2500 Saybolt seconds at 100°F. which may be compounded or contain rust and oxidation inhibitors. The paddle shaft bearing may require a high dropping point and heavy duty type grease of NLGI 2 classification grease. The roller chains can use SAE 20 Grade lubricant recommended for roller chain application. In the case of edible products, a white USP oil may be required.

### LUBRICATION OF BEARINGS, GEARS AND CHAINS

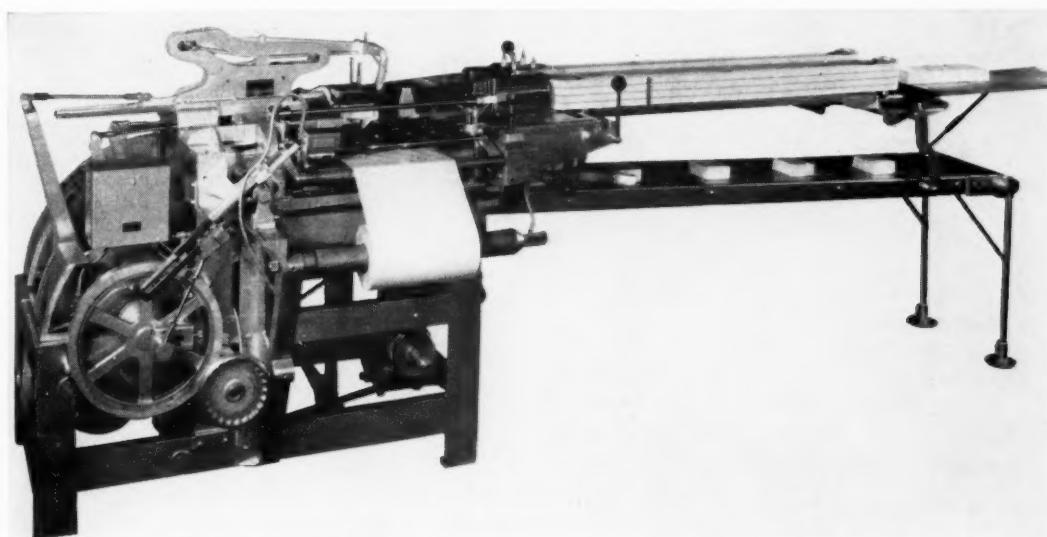
#### Plain Bearings

Plain bearings are those in which sliding represents the major relative motion between the shaft and the bearings. Before recommending the proper grade of lubricant for a particular application, the speed at the journal surface, load, operating temperature and methods of application must be considered. In general, high speed bearings need a lower viscosity oil than low speed bearings. Since the factors for determining the proper lubricant

are not always constant, it is necessary to use a product that will satisfy the range of operating conditions. In addition, the lubricant may be required to perform secondary functions and should have special extreme pressure and anti-wear characteristics. In virtually every bearing application some degree of contamination of the lubricant takes place. It should be determined whether the lubricant can be kept in clean condition or whether additional properties to prevent oxidation, sludge, emulsification, rusting and corrosion are necessary.

#### Ball and Roller Bearings

The selection of a satisfactory lubricant is based upon the requirements and design of the machine. The design of the machine usually determines whether oil or grease is to be applied as the lubricant. The amount of lubricant applied to these bearings should be controlled especially where grease is used. Application of too much grease may push out the seals, cause the bearing to run hot due to internal friction or result in sluggish operation. Relubrication by means of a pressure gun should be handled with care since it is difficult to control the amount of grease charged into the bearing. While grease will assist the performance of a seal against contamination, it does not eliminate the need for adequate seals. Bearings served by oil cups or bottle oilers have the oil level indicated by the level on the oiler. A splash or circulation system generally floods the bearings. In general the oil need only cover up to half the diameter of the lowest ball. Slightly more or less is required depending upon the speed. Drip or wick feed can be controlled to deliver oil adequately and economi-



*Courtesy of Hayssen Manufacturing Co.*

Figure 9 — Wrapping Machine.

cally to a bearing. Many automatic lubricators are available which do an excellent job in dispensing the proper amount of lubricant to bearings. It is well to consider the properties of the lubricant and lubricator to make sure that they do not conflict and cause improper lubrication.

Ball and roller bearings are sensitive to contamination, and dirt of one kind or another is a common cause of trouble. Since it is usually inconvenient and costly to clean and replace bearings, every effort must be made to keep the bearing functioning properly. Only the best grade of lubricant available, specially designed and recommended for ball and roller bearings, should be used. Regular inspection of the seals and housing is well worth the time and effort and any defect found should get immediate attention. It is desirable to inspect the equipment and set up a schedule in some cases for cleaning and repacking bearings when operating conditions are severe. Ball and roller bearings will give excellent service if maintained properly but can be no end of trouble if neglected.

### Gears

A gear lubricant should have certain properties in order to give satisfactory performance. Adhesiveness ensures that a film will remain on the teeth regardless of the action of centrifugal force. This property is especially needed on exposed gears. The viscosity should be adequate to resist the effects of heat or cold and insure that a suitable film is maintained at all times. The lubricant should not channel when exposed to low temperatures and thus result in failure of the teeth. Lubricating ability is required to reduce friction under boundary conditions which occur under high speeds or heavy loads and with certain type gears such as the hypoid.

Three general types of gear lubricants are available for various gears.

1. Straight mineral oils for general lubrication of all type gears, except hypoid, under normal operating conditions.
2. Compounded oils containing polar or fatty materials for bronze or steel worm gears and any others (except hypoid) where this film lubrication condition prevails.
3. Oils containing chemically active extreme pressure additives for all gears, including hypoid, operating under conditions of high speed and low torque, low speed and high torque, shock loading and under high pressures and speeds.

Some of the gear lubricants contain additives which (1) reduce the pour point or channel point so that it will flow freely at reduced temperatures; (2) improve viscosity-temperature relationship of

the lubricant to minimize viscosity spread over wide service temperature range; (3) prevent undue thickening due to oxidation and give longer life to the lubricant; and (4) minimize effects of water and other corrosive material on metal surfaces. There are also other additives to reduce friction, foam and prevent scuffing or galling.

It should be pointed out that a material may not be adequate just because it is viscous or contains a thickener. Some materials can be deceiving in appearance when in reality they give relatively poor protection against wear. The necessary adhesive characteristics may also be low.

The selection of a gear lubricant is based on many factors. Normally a lubricant is recommended on the basis of previous practical field experience under a variety of operating conditions. It is a good practice for the consumer to consult the

*Courtesy of Dewey and Almy Chemical Co.*

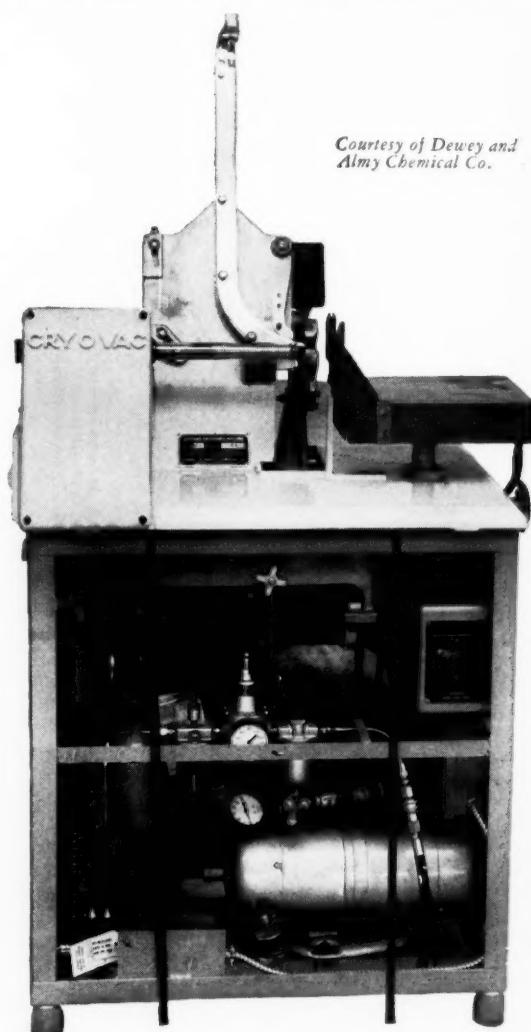


Figure 10 — Packaging Machine which vacuumizes, twists and seals bags.

## LUBRICATION



*Courtesy of The Cincinnati Butcher's Supply Co.*  
Figure 11 — Rendering Cooker.

equipment and gear manufacturers for their recommendations along with the lubricant supplier.

In general each installation may have separate conditions which should be evaluated individually. In low temperature rooms where the units are shut down each night, a product should provide lubrication immediately after starting up as well as at operating temperature. Under some conditions water may be formed in the unit by condensation. In such cases the water should be drawn off before starting. The lubricant may need good water separation properties and also give adequate performance under moist conditions. When the contaminant is a solid material, the lubricant must be sufficiently fluid to wash it out from between the gear teeth. It is quite common for the gear lubricant to serve also as the bearing lubricant in a machine; in this case conflicting lubrication requirements of the gears and bearings may require a compromise in the selection of the lubricant.

### Chains

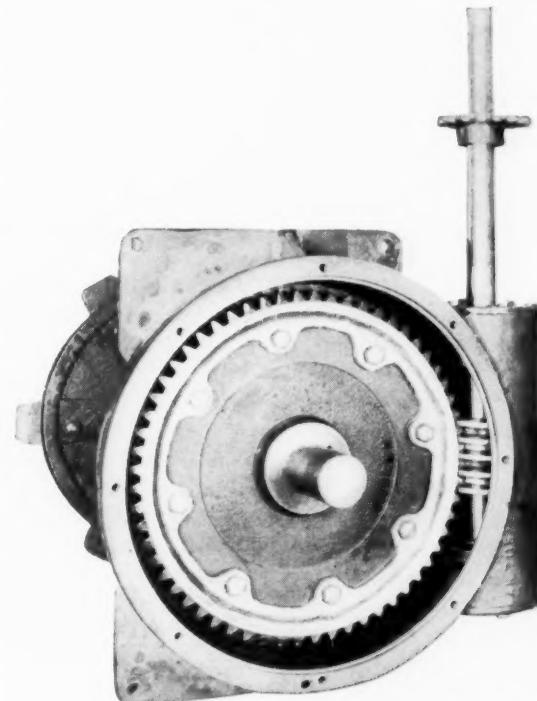
The chain lubricant must penetrate throughout the clearance spaces of the rollers, rockers or sliding surfaces of the links. If the lubricant does not have the proper viscosity to reach all surfaces and remains only on the outer surface, it is not suitable.

The detachable and pintle type chains may or may not be lubricated according to the nature of their service. It is advisable to attempt to lubricate these unless they actually operate in contact with an excess of foreign material where the lubricant would be more of a detriment than a benefit. A relatively heavy gear lubricant is considered to be most effective for detachable and pintle chains. Under conditions where the lubricant is subjected to contamination with dust and dirt, the chains should be cleaned periodically.

The lubrication of roller chain is very important since it is precision made. When the chain is enclosed, oil circulation is provided and it is relatively easy to maintain adequate lubrication. Normally, a good quality straight mineral or additive type of industrial or motor oil ranging from 300 to 1500 seconds Saybolt viscosity at 100°F. depending upon the temperature conditions is satisfactory. In severe operations, mild extreme pressure gear type lubricants may be employed. It is desirable to control the amount of lubricant applied to exposed chains to prevent possible contamination with food products. Since chains in meat plants are exposed to moisture, an oil containing anti-rust inhibitors is highly recommended. Where washing conditions are severe, a lubricant of the proper viscosity which has adhesive properties is recommended.

### SIMPLIFICATION OF LUBRICANTS

The selection of the proper lubricant does not mean that the machine will run trouble free. An equally important factor is getting the right lubricant, in the right place, in the right amount, at the right time. The person who applies the lubricant is one of the most important men in the plant. In spite of the money spent in designing the machine, in research to develop proper lubri-



*Courtesy of The Allbright-Nell Co.*  
Figure 12 — Worm Gear Conveyor Drive.

cants, in study of good lubricating, operating and maintenance practices, it can all be to no avail if proper lubricant does not reach the moving surfaces. To a great extent trouble free operation rests upon the man responsible for lubricating the equipment. His is not an easy task, for the number of lubricants available in a plant may be numerous and each one may be required for different applications. It is easy to see where such a situation may become confusing to the lubrication personnel involved. For the benefit of every one from the purchasing agent to the lubrication personnel, it is highly desirable to limit the number of lubricants coming into a plant. A careful study of the types of machines requiring lubrication should be made and consultation with the petroleum supplier as to characteristics and application recommendation will result in the consolidation of the number of lubricants necessary. Also, the compatibility of lubricants with each other and with lubricators needs to be investigated and considered.

The characteristics in a lubricant demanded by certain types of equipment are quite stringent in that the petroleum product may have to perform in conditions of low or high temperatures, variety of speeds and loads or wet or dry atmospheres, resist oxidation and rusting, resist formation of deposits, and so on. There can be no compromise with the quality of petroleum products needed to meet such requirements. The various types of equipment and the component parts can be listed as to general category. It will be found that the various types of equipment in the plant have many parts in common which require lubrication. After studying the above mentioned factors and characteristics of the lubricants, it will be found that petroleum products of premium quality may be applied to a wider variety of service conditions than those of low quality and in the long run will be more economical. The semi-fluid lubricant with the much needed adhesive qualities also may be used in general lubrication and even reduce consumption and overall cost. The number of greases can be reduced since one product may perform satisfactorily in a wide variety of applications.

The requirements for each plant may vary as to which lubricants may be the final choice. While the day is not here where one oil and one grease will satisfy every need in a plant, it is possible to reduce the number safely to approximately a dozen. For example, in the interest of simplification, the following lubricants may be adequate for several different pieces of machinery. Of course, viscosity requirements may vary and one or two grades may be needed in each type.

Refrigeration oil with a pour point of about  $-30^{\circ}\text{F}$ . and Floc Point of  $-55^{\circ}\text{F}$ . refined to resist

corrosion, oxidation and gum formation can be used for compressors, electric motors, general lubrication of bearings and pumps.

Steam turbine or hydraulic oils which have rust and oxidation inhibitors can be used for circulating systems, hydraulic systems, steam turbines, electric motors, parallel gear reducers and general lubrication.

Cylinder oil containing a compound with a viscosity of approximately 135 SSU at  $210^{\circ}\text{F}$ . would satisfy general purposes as a steam cylinder oil and worm gear reducer lubricant.

Semi-fluid lubricant with adhesive and dripless characteristics, a pour point of about  $-25^{\circ}\text{F}$ . and a viscosity of approximately 300 Saybolt seconds at  $100^{\circ}\text{F}$ . could be used for packaging or canning machines, overhead general lubrication and where a fluid adhesive product is needed.

An exposed gear and chain lubricant with extra load carrying ability and adhesive properties. The product should be easy to apply.

A general purpose grease of No. 2 NLGI classification capable of operating in wide temperature ranges, resisting oxidation and rust, insoluble in water and easily pumped can be applied to bearings of all types.

High temperature heavy duty grease for heavily loaded bearings and high temperature conditions which can be applied to anti-friction bearings and plain bearings.

A gear lubricant of SAE 90 and 140 Grade with extreme pressure characteristics which will perform at below freezing temperatures in worm gears, steering gears and drive units.

## CONCLUSION

Lubrication personnel are pleased to see modern designed machinery replacing old outmoded equipment in a meat packing plant. By studying the design and operating conditions, they have found that lubrication requirements of new machines are fulfilled best by premium quality petroleum products. Furthermore, experience has shown that top grade lubricants have wider application which reduces to a minimum the number of petroleum products required in a meat packing plant and ensures economical satisfactory operation over long periods of time. Frank discussion and mutual understanding between representatives of meat packer, equipment manufacturer and lubricant supplier have been the basis for the lubrication progress made to date. Petroleum products with improved anti-rust, adhesive, and water resistant properties are constantly and actively being investigated and developed for the market by the petroleum refiner.

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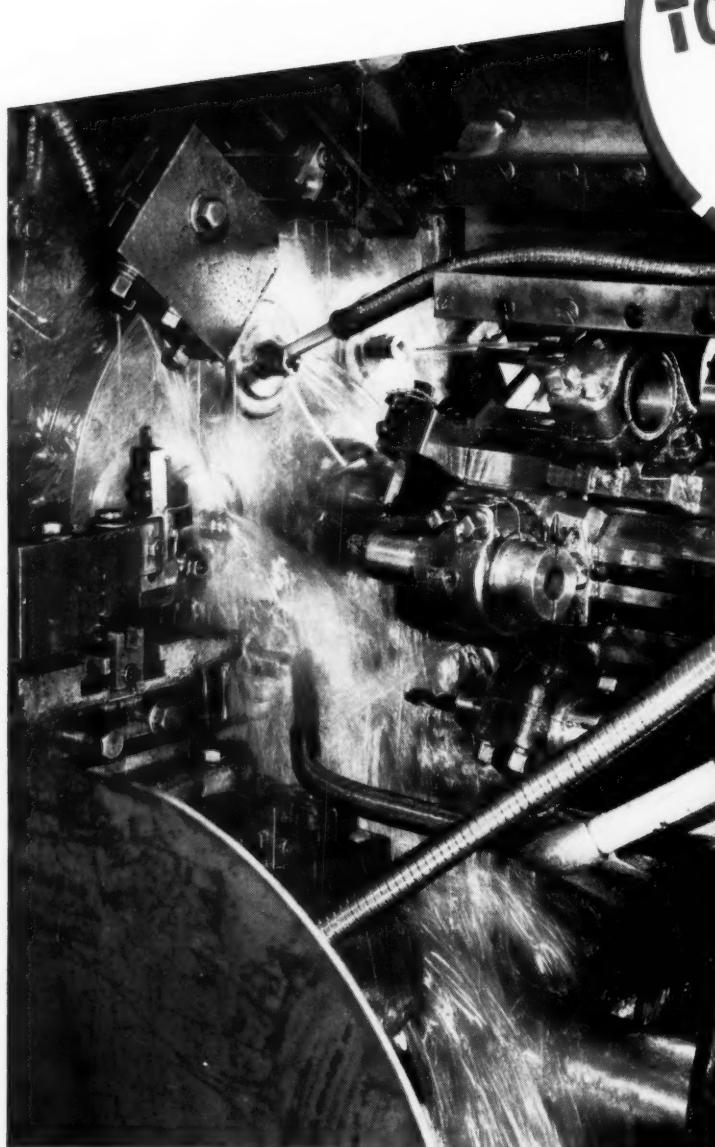
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